Exploration Update

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**Exploration Systems Continues to Translate Plan Into Reality**

- NASA is moving from conceptual studies towards Preliminary Design Review (PDR) as required by our Program Management Framework.
- Completed a “season of System Requirement Reviews (SRR’s)” for the Constellation systems in May 2007
- Kicked off a “season of System Definition Reviews (SDR’s)” with the Orion SDR in August 2007
- Orion/Ares I main components are under contract - December 2007
- Lunar Reconnaissance Orbiter (LRO)/ Lunar Crater Observation and Sensing satellite (LCROSS) scheduled launch in late calendar year 2008
- Pad Abort 1 test: September 2008
- Ares I-X launch: April 2009

<table>
<thead>
<tr>
<th>Flight Systems and Ground Support Projects</th>
<th>Formulation (Phase A)</th>
<th>Implementation (Phase B)</th>
<th>Operations and Sustainment (Phase E)</th>
<th>Disposal (Phase F)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Formulation Approval Document</td>
<td>System Requirements Review</td>
<td>Test Readiness Review</td>
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<td>System Definition Review</td>
<td>Pre-Non-Advocate Review</td>
<td>System Acceptance Review</td>
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<td></td>
<td>Preliminary Design Review</td>
<td>Non-Advocate Review (Approval)</td>
<td>Flight Readiness Review</td>
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<td>Non-Advocate Review</td>
<td>Operational Readiness Review</td>
<td>Decommissioning Review</td>
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We continue to do what we said we would do within budget and commitment milestones.

**Constellation content reflects significant program maturity:**
- Requirements formulation complete heading into Systems Definition Review (SDR)

Restores full funding for cargo demonstration of Commercial Space Transportation Services.

Supports start of Constellation Lunar Phase development in 2011 to achieve Human Lunar Return as quickly as possible (FY 2020 commitment)

Supports Lunar Reconnaissance Orbiter (LRO)/Lunar Crater Observation and Sensing Satellite (LCROSS) launch in late CY 2008

Technology and Human Research content prioritized and aligned to Constellation, Lunar Architecture Team, and Office of the Chief Health & Medical Officer requirements

Continues Utilization of the International Space Station for Exploration and Non-Exploration Research
A year of Acquisition Progress

• **Ares I Crew Launch Vehicle**
  – July 2007, negotiated and awarded Design Development Test & Engineering (DDT&E) contract with Pratt & Whitney Rocketdyne for Ares I upper stage engine
  – August 2007, negotiated and awarded DDT&E contract with ATK Thiokol for Ares I first stage
  – February 2007, competitive Request For Proposal (RFP) released for Ares I upper stage production released, awarded to Boeing end of August 2007
  – June 2007, competitive RFP for Ares I upper stage avionics production released, awarded to Boeing Dec 2007

• **Space Suit System**
  – July 2007 issued Draft RFP. Released RFP in October 2007, award planned June 2008

• **Altair Lunar Lander**

• **Commercial Crew Cargo Program (C3P)**
  – One Partner has completed first eight milestones on schedule
  – Now have one funded and five unfunded Partners;
  – Orbital Science Corp. was selected as a Space Act partner Feb 19, 2008

• **Plans for 2008:**
<table>
<thead>
<tr>
<th>Company</th>
<th>Date awarded</th>
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<tr>
<td>Orion</td>
<td>August 2006</td>
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<tr>
<td>J2-X</td>
<td>July 2007</td>
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<td>1st Stage</td>
<td>August 2007</td>
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<tr>
<td>Upper Stage</td>
<td>August 2007</td>
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<td>Instrumental Unit Assembly (IUA)</td>
<td>December 2007</td>
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Shuttle Transition & Retirement

- Cx transition strategy is to have lunar projects (e.g. Ares V, Lunar Lander) fully underway as soon as possible
- Significant agency effort made during FY 2007 to understand complexity of problem
  - Cx requirements refined: SRR complete, SDR initiated
  - Human Space Flight Capability gaps identified
  - Substantial program (Shuttle, Station, Cx, C3) and institutional cooperation
- Major gaps/threats addressed during this budget formulation process and effort continues
  - Shuttle to Constellation Workforce Mapping (both Civil Service & Contractors) nearing completion to be followed by strategy development
  - Property disposal and Facilities/Infrastructure analysis on-going
  - Development of separate Cx operations budget line, division between ESMD and SOMD budgets premature at this time; anticipate greater fidelity available in next budget process
2007: Technical Progress
Orion and Ares I
2007: Technical Progress
Operations Capabilities

Ground Operations: “Young – Crippen” Firing Room 1

Ares I Pad B Lightning Protection Modifications

Orion Standalone Processing Facility Mods (O&C Facility)
ETDP Technical Highlights

- Demonstrated deployment of solar power system for lunar outpost in Desert RATS field test
- Developed compliant “Tweel” for ATHLETE rover
- Developed six-wheeled chassis for pressurized rover
- Demonstrated 11:1 throttling of RL-10 engine for Lunar Lander descent stage
- Fabricated prototype 5 meter diameter PICA heat shield for Orion
- Demonstrated deployment of solar power system for lunar outpost in Desert RATS field test
ETDP Technical Highlights

Demonstrated oxygen production from simulated lunar regolith

Conducted the Smoke and Aerosol Experiment (SAME) on the ISS

Discovered new fluid behavior in microgravity using Capillary Flow Experiment on the ISS

Demonstrated hydrogen-air fuel cell power system for ATHLETE rover that can carry large payloads over rough terrain

Fabricated proof-of-concept inflatable habitat for lunar outpost

Developed lithium-ion battery for powering portable life support system on EVA suit
HRP Research Highlights

Space radiation exposure cannot be eliminated, only reduced to safe levels.

HRP developed radiation shielding design tools are being used in CEV design analysis cycles to assess exposure levels inside the spacecraft.

A key capability to enable human exploration missions is the ability to conduct safe and productive Extra-vehicular Activities (EVA).

By measuring human physiological performance, HRP is evaluating space suit designs to enable contingency walk-back capability, optimize Lunar EVA operational scenarios, and minimize physiological exertion for Constellation EVA systems.
Longer term spaceflight has a number of effects on the bodies cardiovascular system, muscle strength, and other physiological systems that impact astronaut fitness.

Using the ISS, HRP is developing a systemic measure of overall fitness based on oxygen uptake measurements that takes into account all physiological changes during spaceflight.

Research to inform development of a microbiological standard for long-duration exploration missions is important to crew health and safety.

NASA is undertaking the SWAB experiment that investigates spaceflight effect on microbes and comprehensively evaluates microbes on board the ISS, including pathogens (organisms that may cause disease), using advanced molecular techniques.
LPRP Technical Highlights

LRO: Installation of Thrusters to Flight Propulsion Deck

LCROSS: Attaching Fuel Tank and Aft Skirt to ESPA Ring

LRO: Flight Propulsion Module lift into vibration test facility

LCROSS: Attaching Fuel Tank and Aft Skirt to ESPA Ring
FY ’08 Challenges Ahead

• Programmatic
  – LRO/LCROSS scheduled for end of year launch
  – Integrated Program Management – Performance, Schedule, Budget, Risk
  – Orion point of departure (landing mode, abort system, weight margins)
  – Ares thrust oscillation
  – Ares 1-X Launch preparation
  – Robotic lunar lander program development with Science Mission Directorate
Summary

• ESMD continues to deliver as promised
  - Major work is underway
  - Contracts are in place
  - Our plan is executable
• NASA has planned and paced the multi-decade Constellation program to live within its means, while carefully identifying and mitigating the threats to mission success
• Congress’s continued support in FY 2009 will be critical to ensuring that the strategic direction of the exploration vision can be sustained
• This program will drive us toward new technologies; will enable a new area of economic activity; will strengthen our national security; will engage our technical and engineering workforce; will provide an opportunity to collaborate on important missions with our international partners; and will inspire a new generation of scientists and engineers